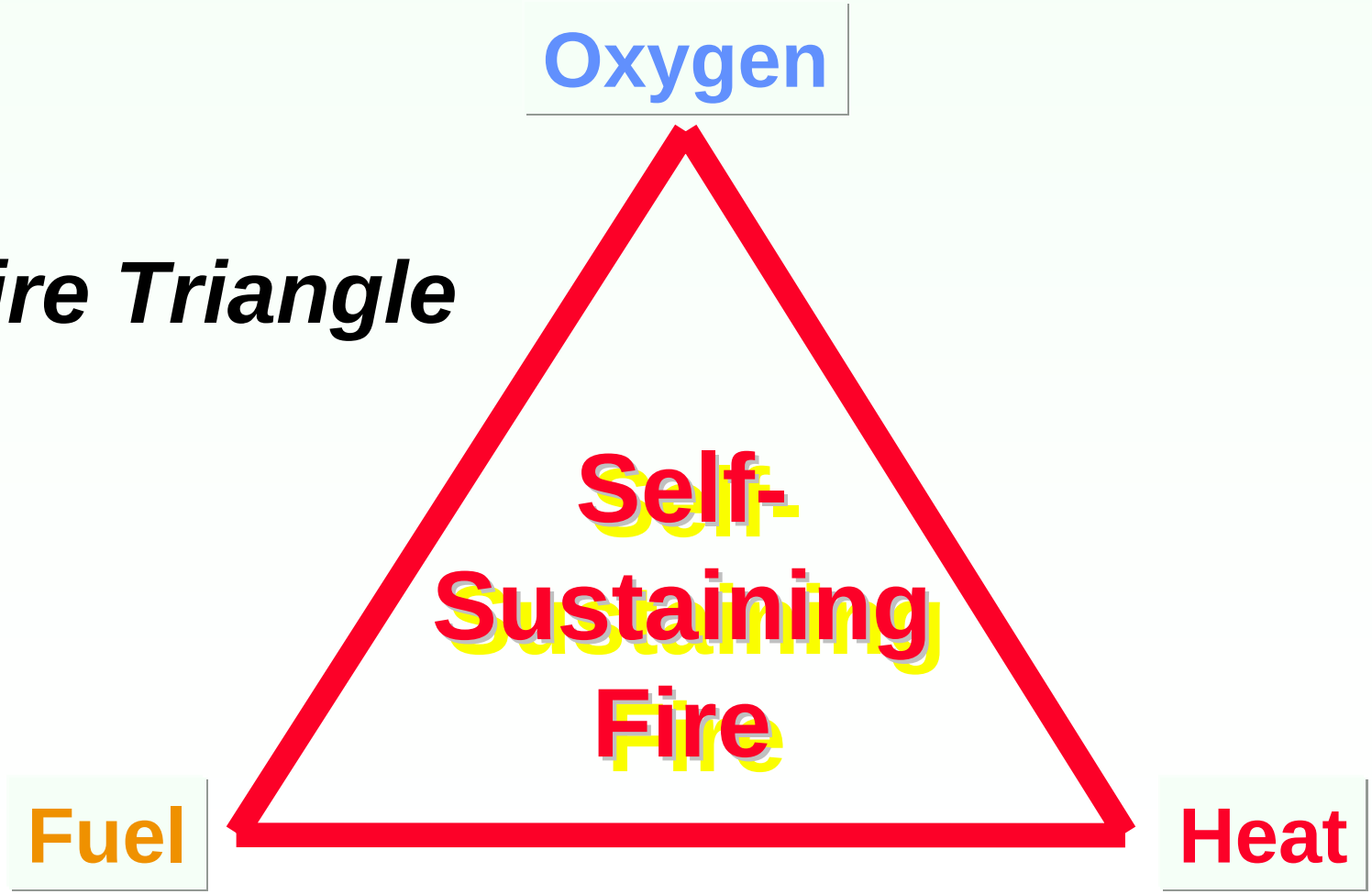
Unit XXVIII, page 129

Pile Fires

Fire Basics

The Fire Triangle



Ignition temperature . . .

the temperature at which more heat is generated by combustion than is lost to the surroundings, so that the combustion process becomes self-sustaining (Energy Technology Handbook, Considine).

The ignition temperature for most organic materials is 205 to 400°F (96 to 205°C).

Heat Sources in a Composting Pile

1. *Biological respiration*
   a) releases heat during biological degradation that is
   b) driven by compostable material (nutrients), moisture, air and organisms.
2. *Chemical oxidation*
   a) begins at about 122°F/50°C,
   b) can be accelerated by heat released during active composting, and
   c) releases heat during chemical breakdown of organic matter.

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Oxidation Ranges

Thermal Oxidation

- CO_2
- H_2O
- Heat

205-1850°F

Chemical Oxidation

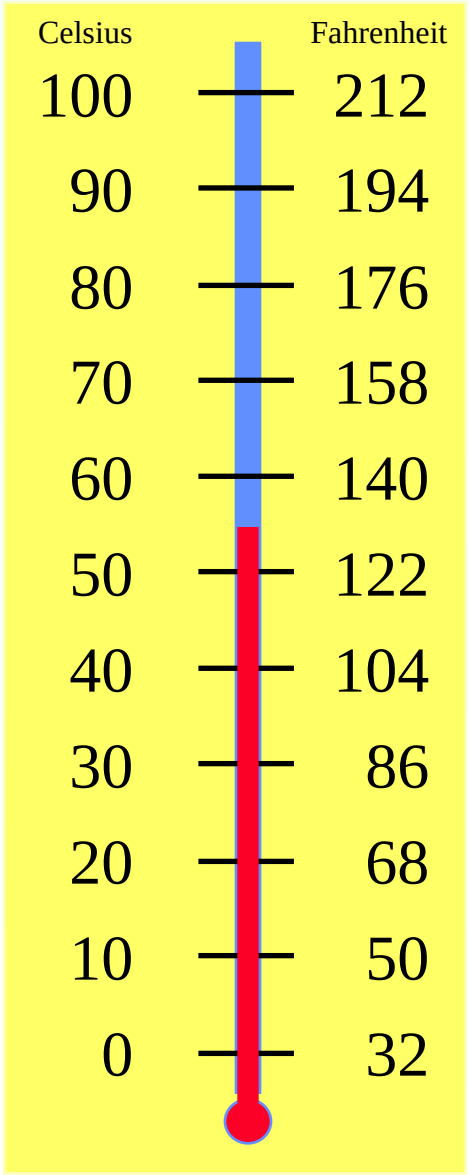
- CO_2
- H_2O
- Heat

122-400°F

Biological Oxidation

- CO_2
- H_2O
- Heat

39-172°F



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How does the fire triangle close in a pile of combustible material . . . *spontaneously*?

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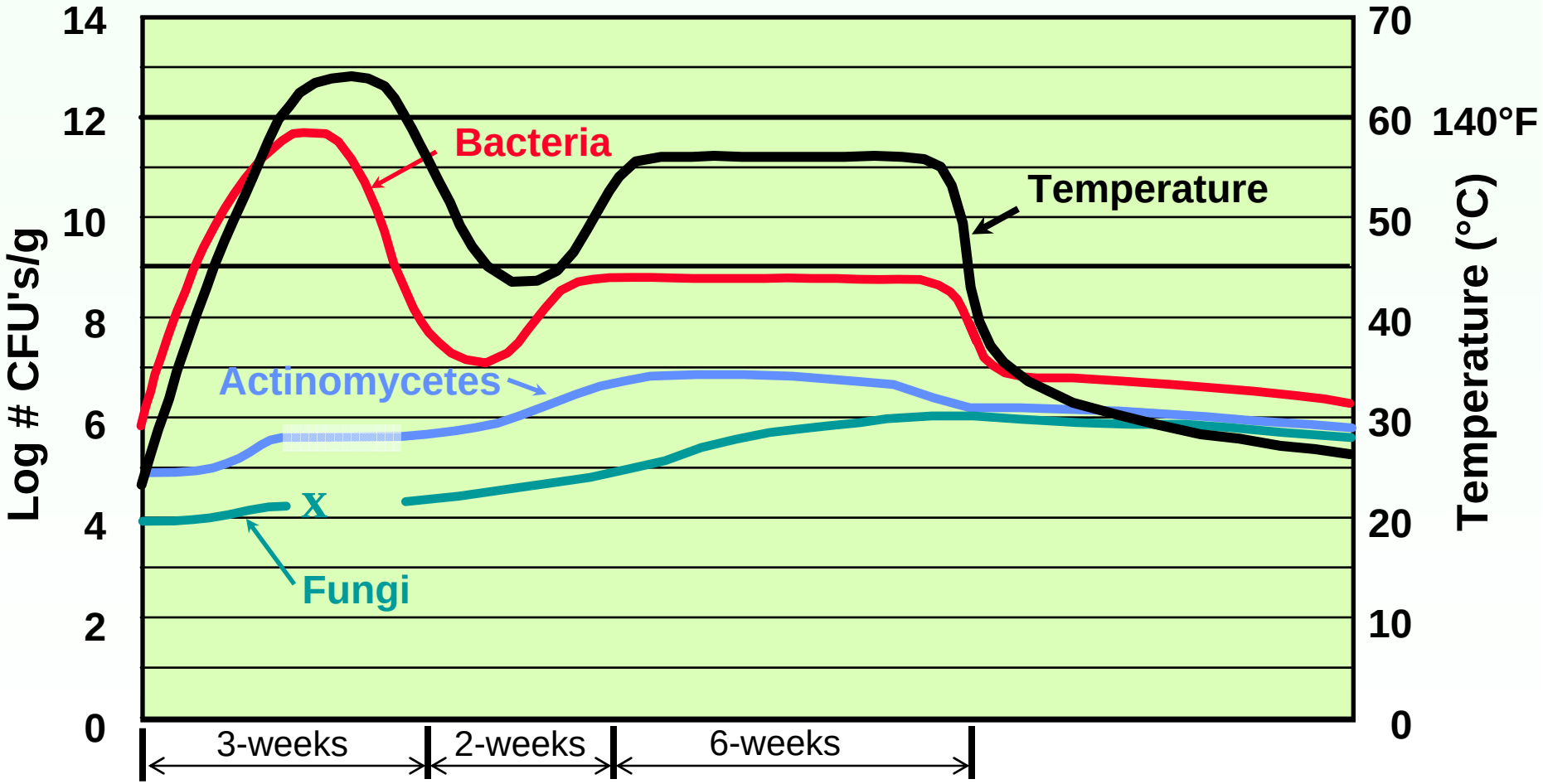
#5

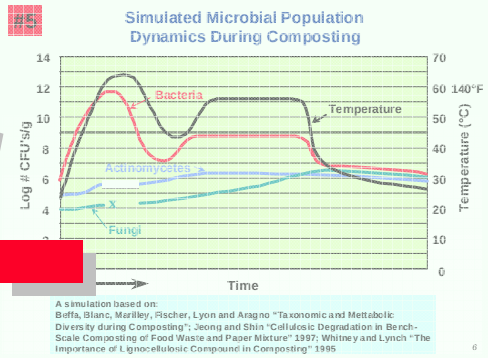
Simulated Microbial Population Dynamics During Composting

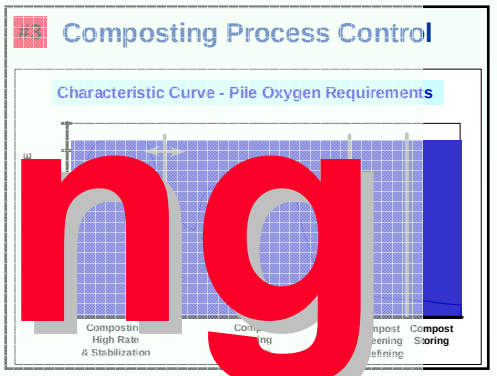


A simulation based on:
Beffa, Blanc, Marilley, Fischer, Lyon and Aragno "Taxonomic and Metabolic Diversity during Composting" 1995; Jeong and Shin "Cellulosic Degradation in Bench-Scale Composting of Food Waste and Paper Mixture" 1997; Whitney and Lynch "The Importance of Lignocellulosic Compound in Composting" 1995.

Self-Sustaining Fire

High porosity in the pile allows an increased supply of oxygen through advective convection





Oxygen

eat

Combustible material

- large high pile (self-insulating)
- decreasing pile moisture percent
- pile dry spots

Vigorous bacterial activity drives chemical oxidation accompanied by rising pile temperature >94°C/200°F

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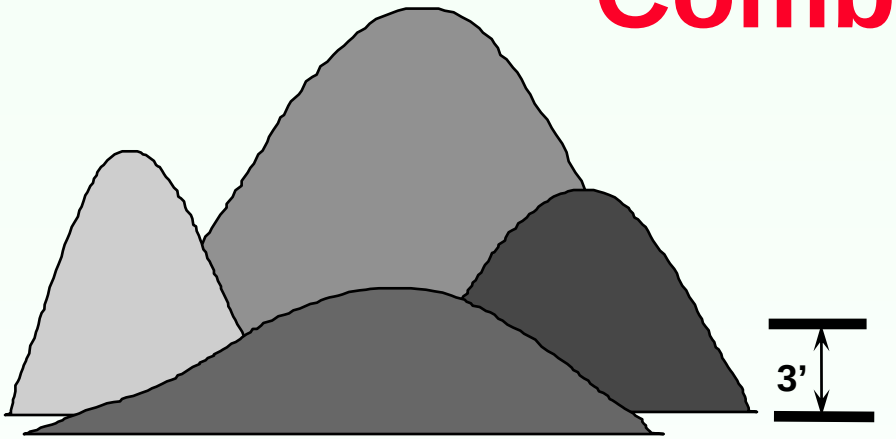
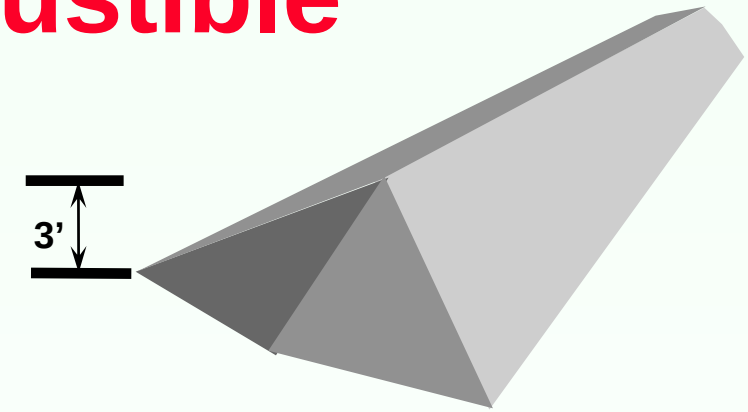
Piles of Compostable Material

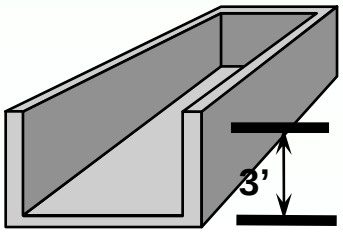
Combustible



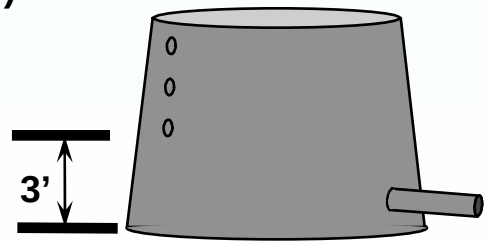
Fresh Debris (Feedstocks)



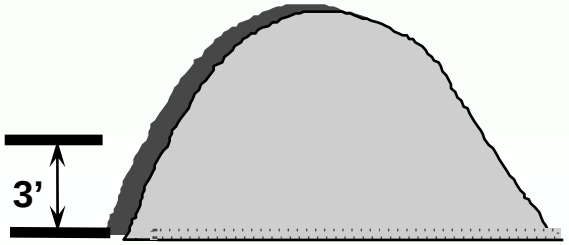
Turned Windrow



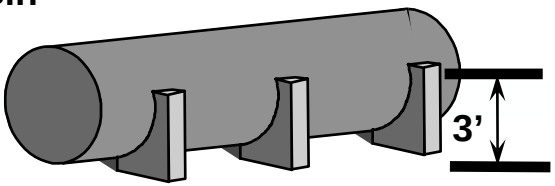
Agitated Bin



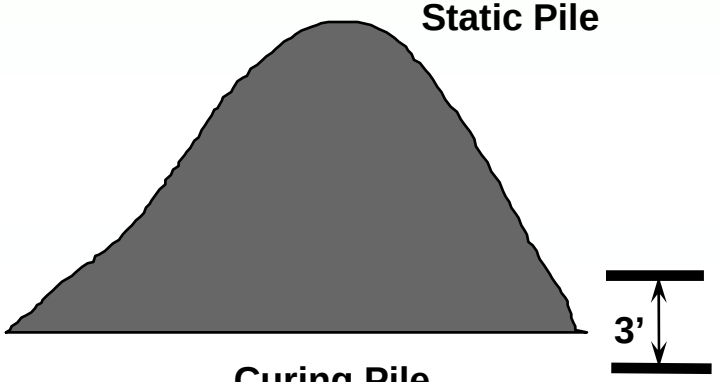
Enclosed Vessel



Static Pile



Rotating Vessel



Curing Pile

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Feedstocks and Conditions Most Susceptible to Pile Fires

- **Raw, green feedstocks that may have already begun decomposing, such as a large brush pile.**
- **Bark chips if given enough moisture to start biological activity.**
- **Large piles of coarse compost, feedstock and screened over-sized material (particle size ~4”), such as bulking material, wood chips and mulch products.**

Prevention of Fires

- **Allow pile heat dissipation by keeping pile height below 2 1/2-meters (8-9 feet)**
- **Keep pile moisture above 40%, and**
- **Keep moisture uniformly distributed**

Monitor pile temperature!

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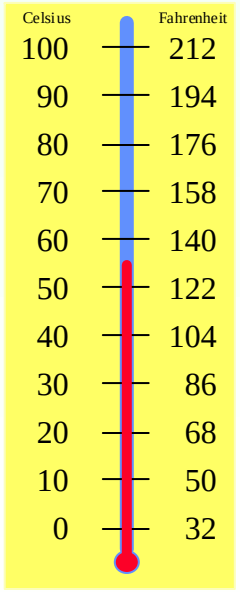
rocess Control

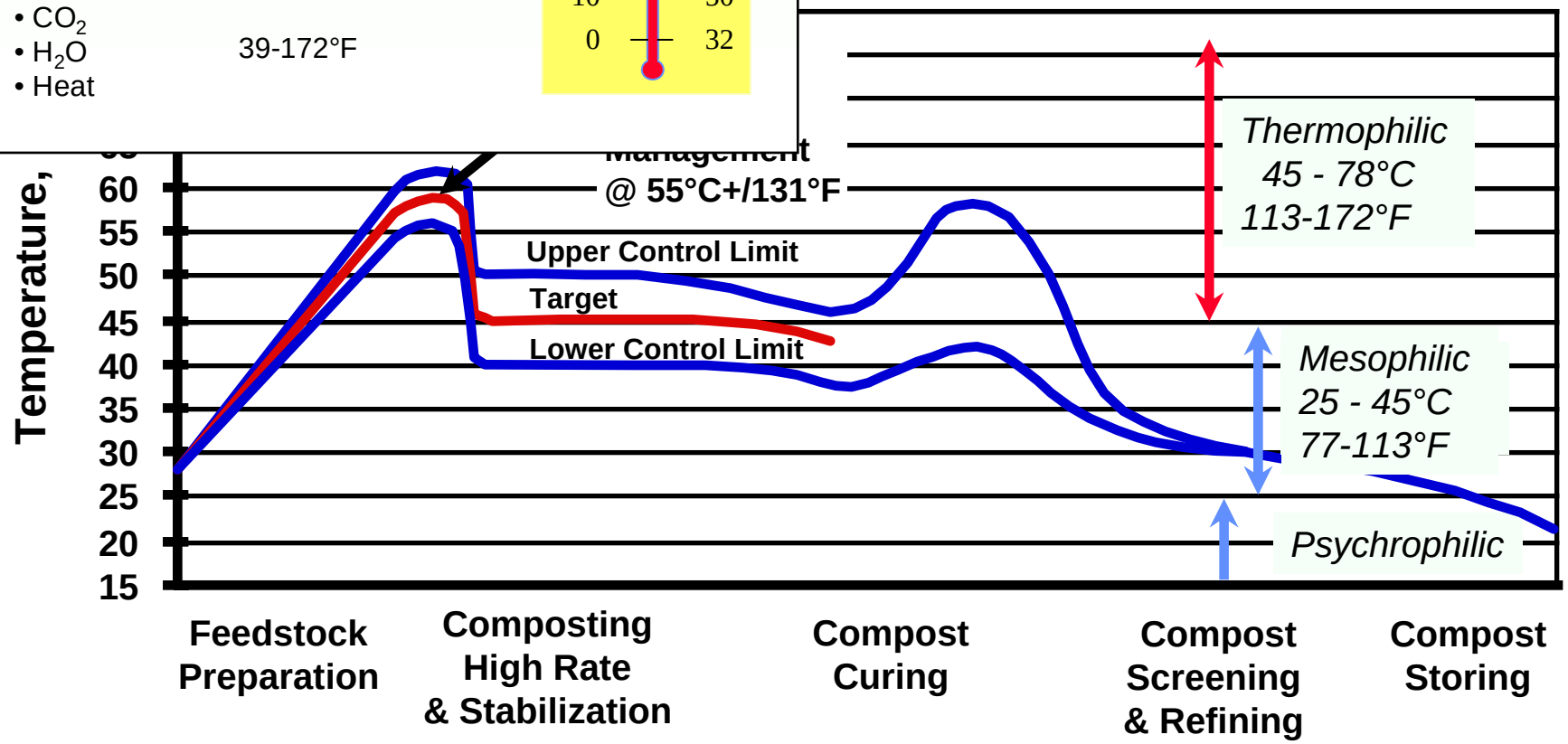
urve - Temperature Impact

Thermal Oxidation
- CO_2
- H_2O 205-1850°F
- Heat

Chemical Oxidation
- CO_2
- H_2O 122-400°F
- Heat

Biological Oxidation
- CO_2
- H_2O 39-172°F
- Heat





Sources of Heat

Spontaneous combustion

Lightning strikes

Cutting torches, welding sparks; vehicle sparks

Grinding sparks; shovel sparks; turning sparks

Cigarettes

Wildfires

Arson

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Sources of Fuel

- Feedstocks and product
- Compost Curing piles
- Woody bulking material piles
- Piles of screened “Overs”
- Methane
- Dust
- Lubricants and fuels
- Refuse and debris piles
- Paper-bag packaging materials
- Office supplies

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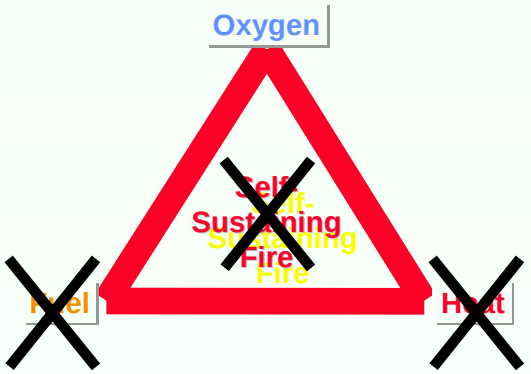
Pile Fires



To Extinguish Pile Fires

- **Reduce pile height to one foot to allow water to get in pile, then**
- **Wet down to remove heat**

Question: **When a pile fire develops, and the Fire Department is called and arrives on the scene, who is in charge?**

Answer: **The law says the Fire Department is in charge of dealing with fires.**

Conclusion: **Facility owner/operators should insure Fire Department personnel understand how to deal with pile fires at your facility and firefighters are trained in advance.**

Fires: Site Design Implications

- **Provide enough space to avoid exceeding the fire-safe height of piles.**
- **Provide access to piles for fire fighting equipment (full perimeter access).**
- **Provide access to adequate supply of water.**
- **Provide space to spread piles out.**

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End Unit XXVIII

Pile Fires